A
TREATISE
On the various Lengths of the
DAYS, NIGHTS, and TWILIGHTS,

WITH

Tables of the Latitude and Longitude of the moſt eminent Towns, Harbours, Headlands, and Iſlands, in the World, and their Bearings and Diſtance from *London*; with a ſhort Diſcourſe on Heat, Cold, and Twilight.

The Whole being very plain and eaſy, diverting and inſtructive.

Illuſtrated with a Copper-Plate, ſhewing

The Length of the Days, Nights, and Twilights, at *Bridge-Town*, in *Barbadoes*, when the Sun is on the Tropicks and Equator.

ALSO,

A moveable Planiſphere, neatly engraved on Copper, which, with a Semi-Circle of Sinical Hours, ſheweth the Time of the Sun's Riſing, Setting, and Length of the Days, Nights, and Twilights in all Parts of the Globe, when the Sun is in the Summer and Winter Solſtices, and the Vernal and Autumnal Equinoxes; with its Deſcription and Uſe.

LIKEWISE

A moveable Orthographical Projection on the Plain of the Equator, with a moveable Index, neatly engraved on Copper, which will ſhew the Situation of any Place on the Globe; and alſo the Difference of Longitude and Time, between any two Places; and will ſolve ſeveral entertaining Queſtions on the Globe; with its Deſcription and Uſe at large.

By RICHARD MIHILL,

Late Midſhipman on Board his Majey's Ship *Elizabeth*.

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M.DCC.LV.

By whom is taught Geography, and the Uſe of the Globes, Maps, and Charts, either at home or abroad.

TO

EDWARD FALKINGHAM, *Eſq*;

ONE OF THE

Commiſſioners of his MAJESTY's NAVY.

THIS TREATISE

Is humbly dedicated,

BY HIS

Moſt obedient humble Servant,

RICHARD MIHILL.

THE

PREFACE.

THE *work I here preſent the reader with is not enrich'd with the flowers of rhetorick, but a plain* Engliſh *treatiſe of my own compiling; and as there are many who know not how to account for the various differences of days and nights, &c. in the ſeveral parts of the globe, I have here explain'd it in as eaſy manner as need be: Not that I preſume to inſtruct the learned, but to enlighten the mind of the weak.*

I firſt begin with an explanation of the tables of latitude and longitude, bearings and diſtance, where only at one view may be ſeen the latitude, longitude, bearings, and diſtance, of the moſt eminent towns, harbours, headlands, and iſlands in the world.

Secondly, *Is ſhewn the lengths of the days, nights, &c. at* Barbadoes, *with a projection, engrav'd on copper, which makes it eaſy to be underſtood.*

Thirdly, *The moveable planiſphere is very inſtructive, by which the reader may eaſily account for the differences of heat, cold, and twilights, in the ſeveral parts of the world, if attention be given to the diſcourſe on thoſe ſubjects.*

Fourthly, *The moveable orthographical projection is both*

both entertaining and inſtructive, which not only ſheweth the difference of time, but will alſo ſhew the motion of the earth round its axis, and demonſtrate that the ſun is always on ſome meridian or other; and I muſt confeſs that there are many who are very weak in their notions of the lengths of the days, nights, &c. and yet are very unwilling to be at a ſmall expence to be inſtructed; as they have now a favourable opportunity, yet willingly neglect it, becauſe they don't underſtand nor perhaps never may; and then another reaſon given by thoſe weak people is, that I am a young author, and to be ſure it is pirated, though they can't tell from where, or from whom. I hope my ſubſcribers will pleaſe to excuſe this ſmall digreſſion, and give me leave to ſay, though the work be but ſmall, yet I hope it will anſwer the end propoſed, in conveying inſtruction to the weak, and pleaſe the learned, who, I hope, will candidly excuſe what's amiſs, as I ſhall at all times be very thankful to any for inſtruction or advice.

Richmond, July
29, 1754.

A TREA-

DESCRIPTION and USE Of the TABLES of LATITUDE, LONGITUDE, &c.

CHAP. I.

THIS treatiſe being intended to ſhew the length of the days, nights, and twilights, and difference of time by the longitude; and, as the uſe of the planiſphere and orthographic projection depends on knowing the latitudes and longitudes of the ſeveral parts of the world, I ſhall begin with the table of latitude and longitude, and ſhewing their uſe, but ſhall firſt explain what latitude and longitude is, as follows:

Latitude and longitude are two primary affections of the earth, by the help of theſe two doth the geographer ſtrive to repreſent the parts of the earth, that they may keep ſymetry and harmony with the whole.

Latitude of a place is the height of the pole above the horizon, or its an arch of the meridian contain'd between the zenith and the equinoctial, equal to the diſtance from the equator to the place.

Longitude is an arch of the equator contain'd between the primary or firſt meridian, (which in my tables is the meridian of *London)* and the meridian of any other place either eaſt or weſt.

Having explain'd what latitude and longitude is, I ſhall next deſcribe the tables, as follows:

They are divided into five columns; the firſt for the places names; the ſecond for the latitude in degrees and minutes either north or ſouth, D. M. being over the figures for degrees and minutes, and N. or S. in a line with them, which ſignifies the latitude is either north or ſouth, or to the northward or ſouthward of the equator.

The third column is for the longitude in degrees and minutes, either eaſt or weſt from the meridian of *London*, and have E. or W. in a line with the figures, which ſignifies the longitude is Eaſt or Weſt.

The fourth column is for the bearings of thoſe places wrote in the firſt column, from *London*; that is, the point of the compaſs they lay on from that place.

The fifth column is for the diſtance of thoſe places mentioned in the firſt column, from *London*, in leagues. Over the columns is expreſſed the part of the world thoſe places lay in.

Thoſe places in the column of latitude with this mark * are my own obſervations, and the others obſervations of ſome eminent mariners who have favour'd me with them from their journals.

Having deſcribed the tables of the latitude and longitude, I ſhall now proceed to their uſe, but ſhall firſt add a table of the points of the compaſs, being very neceſſary to explain the column of bearings.

A Ta-

A Table of the Points of the Compaſs.

North	South
North by Eaſt	South by Weſt
North North Eaſt	South South Weſt
North Eaſt by North	South Weſt by South
North Eaſt	South Weſt
North Eaſt by Eaſt	South Weſt by Weſt
Eaſt North Eaſt	Weſt South Weſt
Eaſt by North	Weſt by South
Eaſt	Weſt
Eaſt by South	Weſt by North
Eaſt South Eaſt	Weſt North Weſt
South Eaſt by Eaſt	North Weſt by Weſt
South Eaſt	North Weſt
South Eaſt by South	North Weſt by North
South South Eaſt	North North Weſt
South by Eaſt	North by Weſt

In order to ſhew the neceſſity of having this table of the points of the compaſs, the following queſtion is propoſed.

Required the latitude and longitude of fort *St George* in the *Eaſt Indies*, with the bearings and diſtance of that place from *London*. By looking over the tables, I find fort *St George* in the *Eaſt Indies* to be in latitude 13 degrees 8 minutes north; longitude 80 degrees 00 minutes eaſt, and to bear from *London* ſouth eaſt by eaſt ¼ eaſt, diſtance 1440 leagues. Now in the column of bearings there is only the firſt letters of bearings, or point of the compaſs, and as there are many people who do not know the compaſs, nor cannot tell the meaning of theſe letters, but by looking over the table of the points of the compaſs may there find the points expreſſed fully, and it may be uſeful to them if the table be got by heart.

I next proceed to the tables, and then to the length of days, nights, and twilights, (at *Bridge-Town*, *Barbadoes)* when the ſun is in the tropicks and equator, which is explain'd by a curious copper plate projection.

A TABLE of the LATITUDES and LONGITUDES of the moſt eminent Towns, Harbours, Headlands, and Iſlands in the World, beginning the Longitude from the Meridian of LONDON, and their Bearings and Diſtance from the ſaid Place.

The Sea Coaſts on the Main Continent in the E. Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
River St Lucia	28 30 S	30 15 E	S.b.E.¼E.	1656
Cape Corientes	23 10 S	35 25 E	S.S.E.	1822
Moſambique	15 04 S	40 30 E	S.S.E.½E.	1510
Port Delgarda	10 17 S	40 10 E	S.S.E.½E.	1421
Magadoxa	2 00 N	44 20 E	S.E.b.S.¼E.	1164
Cape Gardefoy	11 40 N	52 00 E	S.E.¼E.	1108
Mocha	14 40 N	45 00 E	S.E.	1031
Cape Roſulgatt	22 37 N	60 45 E	E.b.S.¾E.	949
Muſcatt	23 32 N	59 45 E	S.E.b.E.¼E.	1082
Baſſora	30 00 N	50 00 E	S.E.b.E.½E.	862
Gambaroon	27 20 N	56 40 E	S.E.b.E.¾E.	947
Surratt	20 56 N	73 05 E	E.S.E.	1308
Bombay Iſland	18 58 N	73 10 E	S.E.b.E.½E.	1338
Goa	15 18 N	74 37 E	S.E.b.E.¼E.	1407
Callecut	11 17 N	75 20 E	S.E.b.E.	1476
Cochin	9 58 N	75 45 E	S.E.¾E.	1507
Anjanga	8 29 N	76 25 E	S.E.b.E:	1519
Cape Commorine	7 55 N	76 55 E	S.E.¾E.	1549
Fort St David's	12 05 N	79 48 E	S.E.b.E.½E.	1525
Fort St George	13 08 N	80 00 E	S.E.b.E.¼E.	1440
Dew Point	16 08 N	81 20 E	S.E.b.E.½E.	1489
Viſagapatam	17 40 N	83 57 E	S.E.b.E.¾E.	1499
Point Palmiras	20 45 N	87 52 E	E.S.E.	1513
Balliſore	21 16 N	87 48 E	E.S.E.¼E.	1504
River Bengall	22 27 N	91 54 E	E.S.E.	1547
Malacca	3 20 N	100 55 E	S.E.b E.½E.	1958

The Sea Coaſts on the Main Continent in the E. Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Siam Entrance	14 18 N	100 50 E	S.E.b.E.¾E.	1797
Cambodia Entrance	10 20 N	105 15 E	E.S.E.	2036
Tonquin	20 50 N	105 40 E	E.S.E.¼E.	1697
Canton	23 20 N	113 05 E	E.S.E.½E.	2130
Amoye Iſland	24 35 N	116 50 E	E.S.E.½E.	1876
Hockſew	26 30 N	118 20 E	E.S.E.¾E.	1872
Limpo	29 58 N	120 20 E	E.S.E.¾E.	1861
Iſland Chuſan	30 00 N	120 35 E	E.b.S.	1874
Nanquin	34 55 N	120 05 E	E.b.S.¼E.	1790
Pekin	39 55 N	117 00 E	E.b.S.¼E.	1637

Iſlands in the Eaſt Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Madagaſcar S. end	26 07 S	46 20 E	S.S.E.½E.	1753
——— N. end	12 03 S	51 45 E	S.E.b.S.¼E.	1562
Mayotta	13 10 S	45 38 E	S.S.E.¾E.	1521
Mohilla	12 15 S	43 53 E	S.S.E.¾E.	1498
Ceylon, S. end	5 50 N	80 15 E	S.E.b.E.	1300
Maldivæ, S. part	0 30 N	76 35 E	S.E.½E.	1216
——— N. part	7 07 N	73 05 E	S.E.¾E.	1508
Manilla	13 55 N	117 06 E	E.S.E.	2047
Aynian, N.W. part	19 30 N	107 10 E	E.S.E.¼E.	1822
Japan, S.E. part	35 30 N	135 30 E	E.b.S.¼E.	1973
Iſland Cocos	14 10 N	91 02 E	S.E.b.E.¾E.	1657
Borneo	4 20 N	109 55 E	S.E.b.E.½E.	2071
N. end of Sumatra	5 30 N	93 50 E	S.E.b.E.¼E.	1743
Bencola	3 50 S	101 18 E	S.E.b.E.	2069
S. end of Sumatra	5 42 S	104 19 E	S.E.b.E.	2060
Batavia Iſland Java	6 15 S	106 09 E	S.E.b.E.¼E.	2090

The

The Southern, or Cape de Verd *Iſlands.*

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
St Antonio	17 12 N	25 40 W	S.S.W.¾W.	830
St Vincent	16 48 N	25 29 W	S.W.b.S.¼W.	827
St Lucia	16 45 N	25 16 W	S.W.b.S.	828
St Nicholas	16 35 N	24 22 W	S.S.W.¾W.	826
Iſle de Sall	16 45 N	22 35 W	S.S.W.¼W.	824
Bona Viſta	16 05 N	22 27 W	S.S.W.	825
Mayo, or May	15 10 N	22 25 W	S.b.W.¾W.	838
St Jago	15 08 N	23 16 W	S.S.W.	848
Fuogo	14 45 N	23 55 W	S.b.W.¾W.	863
St Paul	1 20 N	24 30 W	S.S.W.	1067

The Canary Iſlands.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Madeira, W. end	32 20 N	17 30 W	S.W.b.S.	480
Salvages	30 00 N	16 50 W	S.S.W.¾W.	497
Ferro	28 00 N	18 05 W	S.S.W.½W.	596
Picoteneriff	28 25 N	17 15 W	S.S.W.¾W.	556
Grand Canaria	27 40 N	16 10 W	S.S.W.¼W.	560
Allegranſa	28 55 N	12 53 W	S.S.W.	488
Lancerretto	28 32 N	13 10 W	S.S.W.¼W.	520
Fortoventura	27 35 N	13 50 W	S.S.W.½W.	536

The Sea Coaſts of Greenland.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Hacluit's Headland	79 55 N	11 00 E	N.¾E.	585
Fair Foreland	79 18 N	10 50 E	N.½E.	568
Cape Cold, the N. end of Charles Iſle ——	79 00 N	10 00 E	N.¼E.	563
Black Point, S. end	78 00 N	10 30 E	N.¾E.	545
Dear Sound	79 15 N	12 40 E	N.½E.	549
Foul Sound	77 30 N	12 50 E	N.b.E.	545
Bell Sound	77 15 N	12 40 E	N.b.E.¼E.	543

Horn

The Coaſts of Greenland.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Horn Sound	76 40 N	13 36 E	N.b.E.½E.	540
Point Lookout	76 25 N	15 36 E	N.b.E.¾E.	537
Helies Sound	79 15 N	21 50 E	N.N.E.	560
Cape Barcan	78 25 N	22 11 E	N.N.E¼E.	571
Cape Blanco	77 50 N	22 30 E	N.N.E.½E.	567
Ducks Cove } Edge's	77 45 N	23 10 E	N.N.E.¾E.	580
Negro Point } Iſle	76 55 N	23 30 E	N.E.b.N.	554
Hope Iſland	76 20 N	23 45 E	N.E.b.E.¼E.	540
Cherry Iſland	74 50 N	18 08 E	N.N.E.¾E.	507
Ice Point	77 40 N	69 10 E	N.E.	707
Admiralties Iſle	75 05 N	59 50 E	N.E.b.N¼E.	640
Langeneſs	74 40 N	53 36 E	N.E.b.N.	625
Croſs Point	72 00 N	53 12 E	N.E.b.N.¼E.	605
Fretum Bourough	70 00 N	61 20 E	N.E.b.E.	650
Colgoyen Iſle	69 20 N	45 00 E	N.E.b.N.	600
Cape Candenoſe	69 25 N	42 35 E	N.N.E¾E.	535
Cape Barſo	66 30 N	38 00 E	N.E.	510

Sea Coaſt from Arch Angel *to the Naze of* Norway.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Archangel	64 30 N	40 30 E	N.E.b.E.¼E.	480
Cape Grace	66 00 N	36 30 E	N.E b.E.	481
Cape Gallant	68 10 N	34 45 E	N.E.¾E.	495
Fiſhers Iſland	70 00 N	26 38 E	N.E ½E.	420
North Cape	71 25 N	23 02 E	N.E.¼E.	435
North Point	62 20 N	5 26 E	N.N.E.	230
Katts Neſs, S. Point	61 45 N	3 36 E	N.b.E.¾E.	204
North Bergen	60 15 N	5 40 E	N.N.E.¼E.	185
Jedder	58 10 N	6 10 E	N.E.b.E.¾E.	155
Naze of Norway	58 00 N	7 22 E	N.E.¼E.	140
Maſterland	57 50 N	11 40 E	N.E.¾E.	170

Sea

Sea Coaſt in the Sound.

Places Names.	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Maerden	58 25 N	8 55 E	N.b.E.¼E.	172
Caperwick	59 20 N	10 10 E	N.b.E.½E.	190
Chriſtiana	59 45 N	10 00 E	N.b.E.¼E.	193
Gottenburg Gat	58 07 N	12 15 E	N.N.E.	180
Cape Kol	56 30 N	12 12 E	N.N.E.¼E.	181
Elſenburg	56 20 N	12 30 E	N.E.b.E.	163
Valſterborn	55 35 N	13 00 E	N.E.b.E.¼E.	177
Chriſtianople	56 20 N	16 00 E	N.E.b.E.½E.	193
Calmer	56 45 N	16 35 E	N.E.b.E.¾E.	205
Oeland, the N. end	57 25 N	17 00 E	E.N.E.	220
Stockholm	59 20 N	18 15 E	N.E.b.E.½E.	240
Raſeburgh	60 28 N	22 35 E	N.Eb.E.¾E.	335
Peterſburgh	60 30 N	30 20 E	E.N.E.¼E.	370
Narva	59 47 N	28 25 E	E.N.E.	348
Revell	59 35 N	24 51 E	N.E.b.E.½E.	300
Parnaw	58 25 N	23 30 E	N.E.b.E.¼E.	285
Runon Iſland	57 55 N	24 00 E	E.N.E.	290
Riga	57 04 N	25 15 E	E.N.E.¼E.	295
Domeneſs	57 30 N	24 00 E	E.N.E.	285
Coningſberg	54 43 N	21 35 E	E.N.E.¾E.	255
Dantzick	54 04 N	19 02 E	E.N.E.½E.	222
Gotland, S. end	58 03 N	18 50 E	N.E.b.E.½E.	228
Bornholm	55 15 N	14 45 E	N.E.b.E.¼E.	180
Rugen	54 45 N	14 00 E	N.E.b.E.½E.	170
Straelſound	54 37 N	13 16 E	N.E.b.E.¾E.	150
Lubeck	54 46 N	9 55 E	N.E.½E.	130
Copenhagen	56 13 N	12 50 E	N.E.b.E.	155
Elſenore	56 33 N	12 32 E	N.E.b.E:	160
Uraniberg	55 54 N	12 50 E	N.E.b.E.¼E.	150
Anout Iſland	57 10 N	11 06 E	N.E.¾E.	165
Leſon, or Leſnow Iſland	57 05 N	10 30 E	N.E.½E.	161
The Scaw	57 26 N	10 10 E	N.E.¼E.	167

Sea Coaſts of Holland *and* Flanders *from the* Scaw *to* Calais.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Holyland, or Helighland Iſle	54 24 N	08 35 E	N.E.b.E.½E.	118
Hambrough	53 41 N	10 35 E	N.E.b.E.¾E.	115
Bremen	53 50 N	9 00 E	N.E.b.E.½E.	110
Embden	53 05 N	7 35 E	N.E.b.E.	90
Ameland Iſland	53 30 N	6 20 E	N.E.b.E.½E.	88
Scheling	53 25 N	5 58 E	N.E.b.E.¼E.	82
The Fly	53 15 N	5 30 E	N.E.b.E.	77
The Texell	53 15 N	5 10 E	N.E.b.E.	70
Amſterdam	52 23 N	5 10 E	N.E.b.E.¾E.	60
Rotterdam	51 55 N	4 20 E	E.N.E.½E.	55
Antwerp	51 10 N	4 20 E	E.¾S.	51
The Brill	52 00 N	4 00 E	E.b.N.	57
Middleburgh in Zealand	51 35 N	3 57 E	E.b.N.¾E.	56
Sluys	51 14 N	3 43 E	E.½S.	54
Oſtend	51 07 N	3 25 E	E.¾S.	59
Dunkirk	51 01 N	2 27 E	E.b.S.	48

The Sea Coaſts of France *and* Portugal.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Calais	50 57 N	1 50 E	E.S.E.	30
Diepe	49 56 N	1 55 E	S.E.¼E.	37
St Valery	50 10 N	0 56 E	S.S.E.½E.	31
Sain Head, or Cape de Antifer	49 44 N	0 34 E	S.b F.	28
Rouven Mouth	49 36 N	0 30 E	S.⅓E.	26
Cape Barfleur	49 47 N	1 12 W	S.W.b.W.	40
Cape de la Hague	49 48 N	2 03 W	W.S.W.	61
Alderney	49 50 N	2 12 W	W.S.W.¼W.	63
Caſketts	49 50 N	2 17 W	W.S.W.½W.	65
Guernſey	49 36 N	2 38 W	W.S.W.¼W.	67
Jerſey	49 20 N	2 18 W	S.W.b.W.¾W.	65

St

The Sea Coaſts of France *and* Portugal.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
St Maloes	48 38 N	2 05 W	S.W.b.W.	76
Morlaix	48 36 N	3 49 W	S.W.b.W.½W.	82
Iſland de Baſs	48 50 N	4 00 W	S.W.b.W.¾W.	88
Uſhant*	48 30 N	5 06 W	W.S.W.	96
Conquett	48 25 N	5 05 W	W.S.W.¼W.	99
Breſt	48 23 N	4 25 W	W.S.W.	85
Camarita Bay	48 25 N	4 28 W	W.S.W.	80
Bell Iſle*	47 17 N	3 15 W	S.W.b.S.	95
Nantz	47 15 N	1 49 W	S.S.W.	85
Iſle de Rey, the Middle	46 10 N	1 30 W	S.b.W.	96
Rochell	46 10 N	0 58 W	S.½W.	95
Bourdeaux City	44 55 N	0 25 W	S.¼W.	130
St Sebaſtian	43 32 N	1 27 W	S.¾W.	158
Bilboa	43 32 N	2 58 W	S.b.W.	165
Cape Ortegall*	44 02 N	7 42 W	S.W.¼W.	190
Cape Finiſtere*	43 10 N	9 40 W	S.W.½W.	229
Oporto*	41 18 N	9 25 W	S.W.b.S.¼W.	255
Burlings*	39 40 N	10 30 W	S.W.b.S.	260
Rock of Liſbon*	39 00 N	9 50 W	S.S.W.¼W.	258
Liſbon City	38 43 N	9 02 W	S.S.W.½W.	291
Cape St Vincent*	37 06 N	9 30 W	S.S.W.	332
Cape St Maria*	36 58 N	8 30 W	S.b.W.¾W.	329
Cadiz	36 18 N	6 29 W	S.b.W.	325
Cape Trefalgar*	36 10 N	6 30 W	S.b.W.¼W.	335

The Sea Coaſts on the Main Continent within the Streights.

Gibraltar*	36 10 N	5 20 W	S.b.W.½W.	337
Malaga*	36 50 N	3 17 W	S.½W.	310
Cape de Gatt*	36 57 N	1 30 W	S.¼W.	312
Cape Paul*	37 50 N	0 15 W	S.⅛W.	325
Alicant*	38 35 N	1 20 E	S.¾E.	270
Cape Martin*	38 50 N	1 45 E	S.b.E.	277

Bar-

The Sea Coaſts of the Main Continent within the Streights.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Barcelona*	41 26 N	2 35 E	S.b.E.½E.	220
Marſeilles*	43 20 N	5 27 E	S.S.E.	189
Toulon*	43 07 N	5 50 E	S.S.E¼E.	193
Genoa*	44 27 N	9 50 E	S.E.¾E.	200
Leghorn*	43 18 N	10 30 E	S.E.½E.	207
Civita Vechia	42 04 N	11 50 E	S.E.¼E.	218
Rome	41 54 N	12 57 E	S.E.b.E.	265
Naples	40 57 N	14 27 E	S.E.b.E.¼E.	291
Cape Spartevento	38 00 N	17 30 E	S.E.b.E.½E.	330
Cape Collone	39 10 N	18 05 E	S.E.b.E.¾E.	327
Gallipoli	40 08 N	19 00 E	E.S.E.¼E.	328
Cape St Maria	39 55 N	19 30 E	E.S.E.	332
Ancona	43 40 N	14 53 E	S.E.b.E.½E.	215
Venice	45 40 N	12 50 E	E.S.E.	209
Lepanto	38 25 N	22 50 E	S.E.b.E.¼E.	429
Cape Matapan	36 40 N	23 25 E	S.E.b.E.	470
Cape St Angelo	36 45 N	24 10 E	S.E.b.E.¼E.	481
Athens	38 00 N	24 45 E	S.E.b.E.¾E.	455
Cape Martelo, S. point of Negropont	38 00 N	26 00 E	E.S.E.	468
Cape Monte Sancto	40 05 N	26 10 E	E.S.E.¼E.	457
Gallipoli	40 30 N	28 00 E	E.S.E.½E.	475
Conſtantinople	41 07 N	29 00 E	E.S.E.¾E.	467
Smyrna	38 28 N	27 24 E	S.E.bE.¾E.	480
Epheſus	37 45 N	27 20 E	S.E.b.E.½E.	490
Antiochetta	36 35 N	32 15 E	E.S.E.½E.	588
Scandaroon	36 35 N	37 05 E	E.S.E.¾E.	605
Antioch	35 54 N	37 20 E	E.S.E.½E.	630
Tripoli	34 35 N	36 54 E	E S.E.¾E.	640
Joppa, or Jaffa	32 30 N	35 15 E	S.E.b.E.½E.	660
Alexandria	31 11 N	30 45 E	S.E.b.E¼E.	650
Cape Ruſatta	33 20 N	22 30 E	S.E.b.E.	570
Cape Miſerato	32 45 N	17 10 E	S.E.b.S.¼E.	455
Tripolly	32 54 N	13 05 E	S.E.b.S.	443
Cape Bona	37 06 N	10 30 E	S.E.b.S.¼E.	351

The

The Sea Coaſts on the Main Continent within the Streights.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Tunis	36 55 N	10 00 E	S.E.b.S.	365
Bona	37 03 N	9 00 E	S.S.E.¾E.	350
Algier	36 40 N	3 05 E	S.b.E.½E.	310
Oran	36 00 N	0 45 E	Eaſterly	335
Cape de tres Forcas	33 35 N	1 30 W	S.¼W.	360
Tetuan	35 28 N	6 14 W	S.b.W.	348
Ceuta	35 45 N	4 55 W	S.½W.	349
Tangier	35 40 N	5 10 W	S.¾W.	347

Iſlands within the Streights.

Tormentura	38 43 N	1 40 E	S.½E.	259
Yvica	39 05 N	2 00 E	S.¼E.	265
Majorca*	39 40 N	3 00 E	S.¾E.	267
Port Mahon, Minorca*	39 45 N	4 00 E	S.b.E.	270
Sardinia, S. end	38 54 N	9 02 E	S.b.E.¾E.	286
Corſica, N. end	42 55 N	10 00 E	S.S.E.	225
Meſſina in Sicily	38 21 N	16 40 E	S.E.¼E.	350
Malta	35 54 N	14 46 E	S.E.b.S.	389
Corfu	39 45 N	21 20 E	S.E.b.E.¾E.	380
Cephalonia	38 15 N	21 49 E	S.E.b.E.½E.	415
Zant	37 47 N	22 04 E	S.E.b.E.¼E.	425
Lemnos	39 45 N	27 14 E	E.S.E.	450
Cape Solomon, Eaſt end of Candia	35 24 N	26 00 E	S.E.b.E.¾E.	535
Rhodes	36 42 N	28 05 E	E.S.E.	512
Eaſt end of Cyprus, Cape St Andrea	35 30 N	36 00 E	E.S.E.¼E.	600

The Sea Coaſts of Barbary *and* Guinea, *from* Tangier *to* Cape Bona Eſperance, *or* Cape of Good-Hope.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Cape Spartell	35 56 N	5 50 W	S.b.W.¼W.	340
Sallee	33 44 N	6 20 W	S.b.W.	380
Cape Cantin	32 16 N	9 10 W	S.b.W.½W.	430
Cape de Geer	30 20 N	10 09 W	S.b.W.	480
Cape Bajadore	26 12 N	15 55 W	S.b.W.¼W.	570
Cape Blanco	20 25 N	17 46 W	S.b.W.	720
Cape de Verde	14 47 N	17 12 W	S.¾W.	830
River of Gambia	13 19 N	16 02 W	S.½W.	827
Cape Corſe	4 42 N	2 24 E	S.¼E.	875
River de Valto, or Accara	5 49 N	3 25 E	S.¼E.	820
Cape Formoſa	4 08 N	7 40 E	S.½E.	940
New Callabar	4 22 N	9 37 E	S.¾E.	926
Old Callabar	3 30 N	10 45 E	S.¾E.	935
River de Cammaronis	3 20 N	11 32 E	S.¾E.	952
River de Angra	0 40 N	1 35 E	S.Eaſterly	1004
Iſland St Thomæ	0 00 N	8 20 E	S.½E.	1020
Iſland Aſcenſion	8 00 S	14 45 W	S.¾E.	1200
Cape Lopas	1 09 S	10 55 E	S.¾E.	1042
Cape Negro	16 08 S	12 31 E	S.b.E.	1350
Iſland St Helena	15 54 S	4 10 W	S.¼W.	1370
Cape St Thomas	23 10 S	14 23 E	S.b.E.	1500
Cape Bona Eſperance, or Cape of Good-Hope	34 17 S	16 35 E	S.b.E.	1750

The Sea Coaſt of Brazille.

Cape Roque	5 00 S	35 47 W	S.b.W.¾W.	1213
Cape St Auguſtine	8 05 S	35 40 W	S.b.W.½W.	1335
River St Franciſco	10 45 S	37 50 W	S.b.W.½W.	1375
Bay de lodos Sanctos	13 00 S	41 00 W	S.b.W.¾W.	1410

Port

The Sea Coaſt of Brazille.

Places Names.	Latitude D. M.	Longitude D. M.	Bearings	League[illegible] Diſtance
Port Segura	16 12 S	41 17 W	S.b.W.½W.	1495
Spirito Sancto	19 56 S	42 12 W	S.b.W.¼W.	1555
Cape Frio	23 05 S	42 46 W	S.b W.	1620
Iſland St Katherines	28 00 S	50 10 W	S.S.W.	1760
River Grande	31 55 S	54 00 W	S.b.W.¾W.	1830
River de la Plata, or Cape St Antonia	35 22 S	57 32 W	S.b.W.¾W.	1926
Cape Blanco	46 50 S	72 05 W	S.W.b.S.	2215
River St Julian	48 42 S	74 34 W	S.W.b.S.	2245
Cape Virgin Mary of Magellan's Straits	52 03 S	75 06 W	S.W.b.S.¼W.	2410
Cape Horn, the S. part of the Iſland Terra del Fuego	57 29 S	79 56 W	S.W.b.S.	2505
Iſland dos Picos	22 30 S	25 16 W	S.S.W.	1510
Iſland de Martinoas	19 30 S	26 28 W	S.S.W.¼W.	1415
Iſland St Maria de Agoſta	18 42 S	28 12 W	S.S.W.¼W.	1430

The Weſtern Iſlands.

Corvo	40 03 N	31 30 W	W.S.W.	513
St George	39 04 N	28 08 W	S.W.b.W.¼W.	473
St Michael	37 57 N	24 27 W	S.W.b.W.	465
St Maria	36 59 N	24 19 W	S.W.b.W.	460

The Sea Coaſts of the North Part of America, Hudſon's-Bay, *and* Newfoundland.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Cape Farewell	59 45 N	46 47 W	N.W.b.W.¾W	540
Cape Elizabeth	62 03 N	66 49 W	W.N.W.	760
Queen Ann's Foreland	63 30 N	74 56 W	W.N.W.¼W.	740
Saliſbury Iſland	63 48 N	77 33 W	W.N.W.½W.	795
Shark Point	64 30 N	82 56 W	W.N.W.¾W.	809
Cape Southampton	62 01 N	87 49 W	W.b.N.	813
Sir Thomas Rowe's welcome	64 15 N	92 06 W	W.¾N.	820
Cape Churchill	59 02 N	93 01 W	W.½N.	817
Port Nelſon, or York Fort	57 10 N	92 56 W	W.¼N.	[illegible]50
New Severn	56 01 N	88 12 W	W.½N.	935
Cape Heneretta Maria	55 07 N	84 10 W	W.¼N.	953
Viner's Iſle	53 05 N	83 13 W	W. Northerly	927
Albany Fort	52 26 N	84 14 W	W. Northerly	920
Rupert's River	51 16 N	79 30 W	W. Southerly	912
Cape Jones	54 55 N	78 59 W	W.b.N.	830
Cape Walſingham	63 02 N	77 56 W	W.b.N.¾W.	860
Cape Charles	62 38 N	75 35 W	W.N.W.	785
Bell Iſland	52 07 N	54 36 W	W.b.N.	610
Cape St John	50 15 N	52 58 W	W.½S.	600
Cape Bonaviſta	49 15 N	52 13 W	W.b.S.	597
Cape Race	46 31 N	51 53 W	W.b.S.½W.	620
Bay of Bulls	47 29 N	51 44 W	W.b.S.½W.	605

Sea Coaſts of Hudſon's-Bay, Newfoundland, *and* New England.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Cape Roy	48 01 N	57 40 W	W.b.S.	675
Placentia Bay	47 54 N	53 35 W	W.b.S.¼W.	635
French Factory	50 10 N	61 10 W	W.½S.	700
Bay of Breſt	52 11 N	54 54 W	W.¼N.	628
Quebeck	47 05 N	68 15 W	W.b.S.	670
Cape Britain	46 09 N	58 30 W	W.b.S.½W.	695
Cape Sable	43 43 N	64 26 W	W.S.W.	716
North Yarmouth	44 08 N	67 45 W	W.S.W.	720
Cape Codd	42 10 N	68 25 W	W.b.S.¾W.	732
Boſton Entrance	42 28 N	69 27 W	W.S.W.	740
Plymouth	42 02 N	68 50 W	W.S.W.	735
Martha's Vineyard	41 04 N	69 07 W	W.S.W.¼W.	940

Sea Coaſts on the Main Continent in the Weſt Indies.

Block Iſland	41 07 N	69 50 W	W.S.W.	953
New York	40 46 N	73 47 W	W.b.S.¾W.	1000
Cape James	39 05 N	73 47 W	W.S.W.	1009
Long Iſland, the Middle	40 48 N	72 35 W	W.b.S.¾W.	990
Cape Charles	37 15 N	74 18 W	S.W.b.W.¾W.	1070
Cape Henry	37 01 N	74 26 W	W.S.W.	1083
Cape Hatteras	35 12 N	74 22 W	S.W.b.W.½W.	1113
Charles Town upon Aſhley River	32 41 N	78 47 W	S.W.b.W.¾W.	1194
Cape Florida	24 48 N	81 54 W	S.W.b.W.½W.	1340
River Spiritus Sanctus, or Miſchiſippi River's Mouth	28 52 N	96 50 W	W.S.W.	1495
Tompeek	22 20 N	100 15 W	W.S.W.½W.	1550
Lava, or Vera Cruz	19 15 N	99 24 W	S.W.b.W.¾W.	1610
Trieſt Iſland	18 11 N	94 46 W	S.W.b.W.½W.	1560

The Sea Coaſts on the Main Continent in the W. Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Campecha	19 21 N	92 44 W	S.W.b.W.¾W.	1553
Cape Honduras	16 24 N	87 52 W	S.W.b.W.¼W.	1533
Entrance of Nicargua	11 16 N	85 16 W	S.W.b.W.	1555
Porto Bello*	9 56 N	80 17 W	S.W.b.W.	1545
Carthagena*	10 33 N	75 26 W	S.W.¾W.	1465
Iſland Curaſoa*	12 40 N	68 15 W	S.W.¾W.	1320
Mouth of the River Oranoque	8 17 N	59 26 W	S.W.½W.	1373
Surinam	6 15 N	56 50 W	S.W.½W.	1293
Cape Orange	4 06 N	51 27 W	S.W.½W.	1270
Mouth of the River Amazones	0 00 N	49 56 W	S.W.b.S.¾W.	1395

The Caribbee Iſlands, *or Iſlands in the* W. Indies.

Tobago, W. end*	11 12 N	59 12 W	S.W.b.W.	1233
Bridge-Town, Barbadoes*	12 56 N	58 49 W	S.W.½W.	1210
Granado*	11 58 N	60 20 W	S.W.¾W.	1272
St Vincent*	13 17 N	60 13 W	S.W.½W.	1250
St Lucia*	14 02 N	60 05 W	S.W.½W.	1225
Martinica*	14 46 N	60 26 W	S.W.½W.	1220
Dominica*	15 25 N	60 32 W	S.W.¾W.	1215
Marigallanta*	15 58 N	60 22 W	S.W.¾W.	1200
Guardalupa*	16 32 N	61 16 W	S.W.¾W.	1203
Deſſeada*	16 21 N	60 12 W	S.W.½W.	1210
Antegoa*	17 27 N	60 36 W	S.W.½W.	1190
Barbuda*	17 52 N	60 40 W	S.W.½W.	1167
Monſerrat*	16 58 N	60 56 W	S.W.¾W.	1198
Rodondo*	17 05 N	61 15 W	S.W.¾W.	1188
Nevis*	17 12 N	61 52 W	S.W.¾W.	1200
St Chriſtophers, or St Kitts*	17 26 N	61 59 W	S.W.¾W.	1190

Eu-

The Caribbee Iſlands, *or Iſlands in the* W. Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Euſtatia*	17 25 N	62 21 W	S.W.b.W.	1205
Saba	17 35 N	62 40 W	S.W.b.W.	1207
St Bartholomew*	18 12 N	62 12 W	S.W.b.W.¼W.	1200
St Martin*	18 14 N	62 10 W	S.W.b.W.¼W.	1198
Anguilla	18 17 N	62 12 W	S.W.b.W.¼W.	1199
St Cruize*	17 50 N	63 31 W	S.W.b.W.	1211
St John de Porta Rica*	18 32 N	64 57 W	S.W.b.W.½W.	1210
Eaſt End of Hiſpaniola*	18 20 N	69 16 W	S.W.b.W.¾W.	1240
Port Royal Jamaica*	17 41 N	76 34 W	W.S.W.	1393
Havannah, Iſland Cuba*	22 43 N	82 56 W	WS.W.¾W.	1410

The Bahama Iſlands, *or Iſlands in the* Weſt Indies.

Bermudas	32 30 N	63 42 W	W.S.W.	980
Bahama Iſland*	27 00 N	79 37 W	W.S.W.½W.	1260
Providence	25 00 N	77 21 W	W.S.W.½W.	1253
Harbour Iſland	25 35 N	76 48 W	W.S.W.¼W.	1240
Elathara, S. point	24 30 N	75 55 W	W.S.W.¼W.	1260
Cat-Iſland, the Middle	24 25 N	75 09 W	W.S.W.¼W.	1258
Watling's Iſland*	24 05 N	74 32 W	W.S.W.	1261
Rum Key*	23 45 N	74 52 W	W.S.W.	1258
Crooked Iſland, N. end*	23 02 N	74 15 W	W.S.W.	1275
Atwood's Keys*	23 10 N	73 35 W	W.S.W.	1265
Long Iſland, South end*	22 45 N	74 54 W	S.W.b.W.¾W.	1290
Mayaguana	22 35 N	72 46 W	S.W.b.W.¾W.	1250
French Keys	22 40 N	73 40 W	W.S.W.	1230
Marapervouz	21 58 N	74 45 W	S.W.b.W.¾W.	1238

Hog-

The Bahama Iſlands, *or Iſlands in the* Weſt Indies.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Hogſties	21 17 N	73 55 W	W.S.W.	1240
Hineaga, W. end*	20 54 N	73 44 W	S.W.b.W.¾W.	1247
Turks Iſland	21 25 N	70 10 W	S.W.b.W.½W.	1238
Weſt Caicos	21 20 N	71 58 W	S.W.b.W.¾W.	1245
Abrolho Bank, the N. end	21 40 N	69 05 W	S.W.b.W.½W.	1235
Plate Wreck	20 20 N	68 16 W	S.W.b.W.¾W.	1229
Iſland Great Camaines	18 46 N	81 28 W	W.S.W.	1425
Little Camaines	19 10 N	80 24 W	W.S.W.¼W.	1410
Pedro Shoales, N. ſide*	17 11 N	77 56 W	S.W.b.W.¾W.	1423
Iſland St Milan	17 10 N	81 28 W	W.S.W.	1473
Iſland de Guayna	16 52 N	88 30 W	W.S.W.¼W.	1530
Iſland Cozumelli	19 25 N	89 04 W	W.S.W.½W.	1490
Zuna Quita	17 03 N	89 44 W	W.S.W.¼W.	1570

The Sea Coaſts about the Iſland of Iceland.

Grimes Hole	66 23 N	29 30 W	N.W.b.W.¼W	390
Weſtmania Iſles	63 45 N	22 54 W	N.W.b.W.	346
Rook Point	64 00 N	26 23 W	N.W.b.W.¼W	375
Snow Hill	65 11 N	27 14 W	N.W.b.W.¼W	380
Merchants Foreland	63 25 N	17 05 W	N.W.¾W.	330
Green's Iſland	66 55 N	24 45 W	N.W.b.W.	395

The

The Sea Coaſts of Scotland.

Places Names.	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Sky Iſland, N. end	57 45 N	5 25 W	N.W.b N.¾W.	145
Shetland, S. end	60 02 N	2 01 W	N.b.W.½W.	167
Iſles of Orkney	59 10 N	3 24 W	N.b.W.¾W.	153
Aberdeen	57 22 N	1 37 W	N.b.W.	119
Dundee	56 28 N	2 40 W	N.b.W.¼W.	130
Leith	56 00 N	2 55 W	N.b.W.½W.	96
Edinburgh	57 55 N	2 55 W	N.b.W.¾W.	91
Berwick	55 50 N	1 40 W	N.b.W.	86

The Sea Coaſts of England.

Newcaſtle	54 58 N	1 30 W	N.b.W.½W.	75
Flamborough Head	54 08 N	0 11 E	N.Eaſterly	71
Yarmouth	52 45 N	1 38 E	N.E.½E.	59
Ipſwich	52 14 N	1 00 E	N.E.¾E.	25
Harwich	52 11 N	1 18 E	N.E.b.E.	24
London	51 32 N	0 00		
North Foreland	51 28 N	1 19 E	E. Southerly	22
The Downs	51 25 N	1 21 E	E. Southerly	15
Beachy	50 48 N	0 25 E	S.E.b.S.	17
Portſmouth	50 48 N	1 00 W	S.W.½W.	24
Iſle of Wight*	50 45 N	1 10 W	S.W.¾W.	30
Portland*	50 30 N	2 28 W	S.W.b.W.	40
Torbay*	50 33 N	3 38 W	S.W.b.W.¼W.	53
The Start Point*	50 09 N	3 45 W	S.W.b.W.¼W.	55
The Eddyſtone*	50 14 N	4 12 W	W.S.W.	64
Lizard*	49 58 N	5 24 W	W.S.W.¼W.	90
Lands End*	50 05 N	6 00 W	W.S.W.¾W.	95
Scilly Iſlands, the Middle*	50 01 N	6 45 W	W.b.S.	100
St David's Head	51 00 N	5 22 W	W. Southerly	92
Iſle of Man, W. end	53 45 N	5 00 W	N.W.b.W.	102

The Sea Coaſts of Ireland.

Places Names	Latitude D. M.	Longitude D. M.	Bearings	Leagues Diſtance
Dublin	53 12 N	6 55 W	N.W.b.W.¼W	103
Old Head of Kinſale	51 35 N	8 58 W	W.Northerly	132
Cork	51 49 N	9 30 W	W.Northerly	140
Cape Clear	51 10 N	10 30 W	W.Southerly	152

A Table of ſome eminent Cities in the World, &c.

Acapulco, in Mexico	17 32 N	106 22 W	W.S.W.	1670
Agra, the Mogul's Court	28 34 N	83 20 E	E.S.E.	1325
Paris, France	48 53 N	2 22 E	S.E.¼S.	70
Brunſwick, Hanover	52 30 N	5 45 E	N.E.b.E.½E.	117
Madrid, Spain	40 12 N	3 21 W	S.b.W.½W.	225
Moſcow, Ruſſia	55 36 N	38 50 E	N.E.b.E.½E.	490
Prague, Bohemia	50 42 N	14 36 E	E. Southerly	190
Iſpahan, Perſia	36 15 N	65 05 E	S.E.b.E.¾E.	945
Vienna, Germany	48 22 N	17 20 E	E.N.E.	230

CHAP.

CHAP II.

Length of Days and Nights at Bridge-town, Barbadoes.

IN the projection (*Plate* I.) the pole is elevated 12 degrees 58 minutes north, which is the latitude of *Bridge-town* in the Iſland of *Barbadoes*. It is intended to ſhew the lengths of the days, nights and twilights on *March* 21, *June* 21, *September* 23, and *December* 21, which muſt be done by the help of the ſemicircle of ſinical hours; the uſe of which I ſhall ſhew after I have explain'd the circles of this projection.

1*ſt*. You are to ſuppoſe this projection to be a globe, the eye being vertical at the center I, and the meridian of the place C A B D, on which the ſun cometh at noon, and at midnight on ſome part or other.

2*d*. I ſhall deſcribe the equator Æ I Q; this circle devides the globe into two equal parts; when the ſun is on this line it is equal day and night in all parts of the world.

3*d*. The tropick of cancer T K, is 23 degrees 30 minutes diſtant from the equator; when the ſun is on this line it is the longeſt day, and the ſhorteſt night to the inhabitants to the northward of the equator; and the ſhorteſt day and longeſt night to the inhabitants to the ſouthward of the equator.

4*th*. The tropick of capricorn T G is 23 degrees 30 minutes diſtant from the equator; when the ſun is on this line it is the ſhorteſt day and longeſt night to the inhabitants to the northward of the equator, and the longeſt day and ſhorteſt night to the inhabitants to the ſouthward of it.

5*th*. The horizon is the great circle H L O, 90 degrees diſtant from the zenith and nadir, and divides the world into the upper and lower hemiſpheres.

6*th*. The diſtance between H E, and O F, which is neither dark nor light, is the twilight, and is 18 degrees 00 minutes, or 1 hour 12 minutes below the horizon. But as you go to the northward or ſouthward of the equator it is greater; but take notice that the twilight is quicker in the winter than in the ſummer. The reaſon for which will be ſhewn in the diſcourſe on the twilight. The dark part from F N and E N is night.

7*th*. The axis or ſix o'clock line; the extremities of which is the north pole N. P. and the ſouth pole S. P. The circles A B and C D, are the arctick and antarctick circles, and are diſtant 23 degrees 30 minutes from the pole.

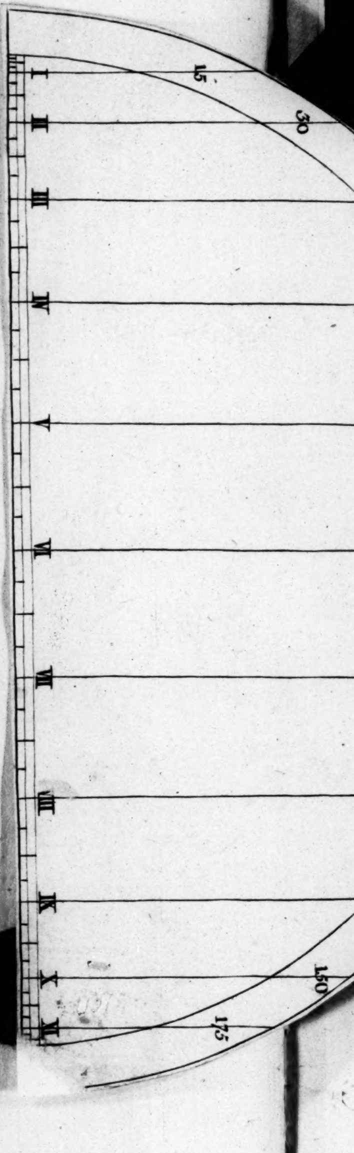
8*th*. The zenith is the point on which is Z; its diſtance from the equator is equal to the heighth of the pole from the horizon, being the latitude of the place.

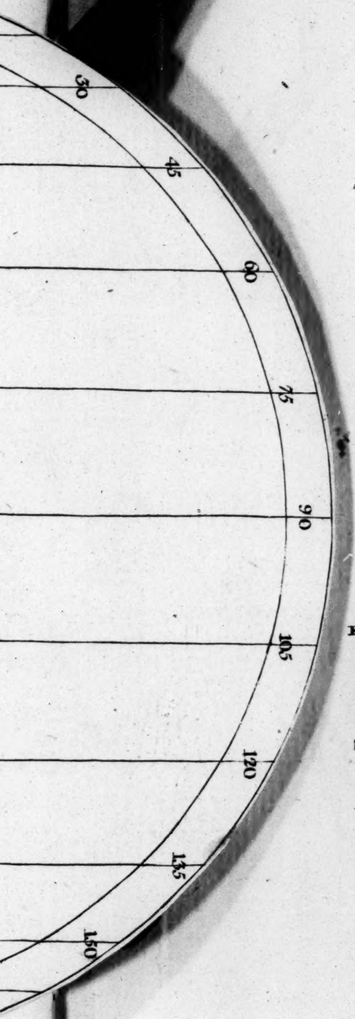
Having deſcribed the circles I ſhall proceed to explain the ſun's courſe from the equator to the tropicks.

The ſun, from *March* 21 to *June* 21, declines from the equator Æ Q, northward to the tropick of cancer T, at which time the ſun riſeth at 37 minutes after 5; at the horizon L, the twilight being 1 hour 22 minutes; ſo the longeſt day is 12 hours 46 minutes; and the ſun ſetteth 23 minutes after ſix on the ſame day.

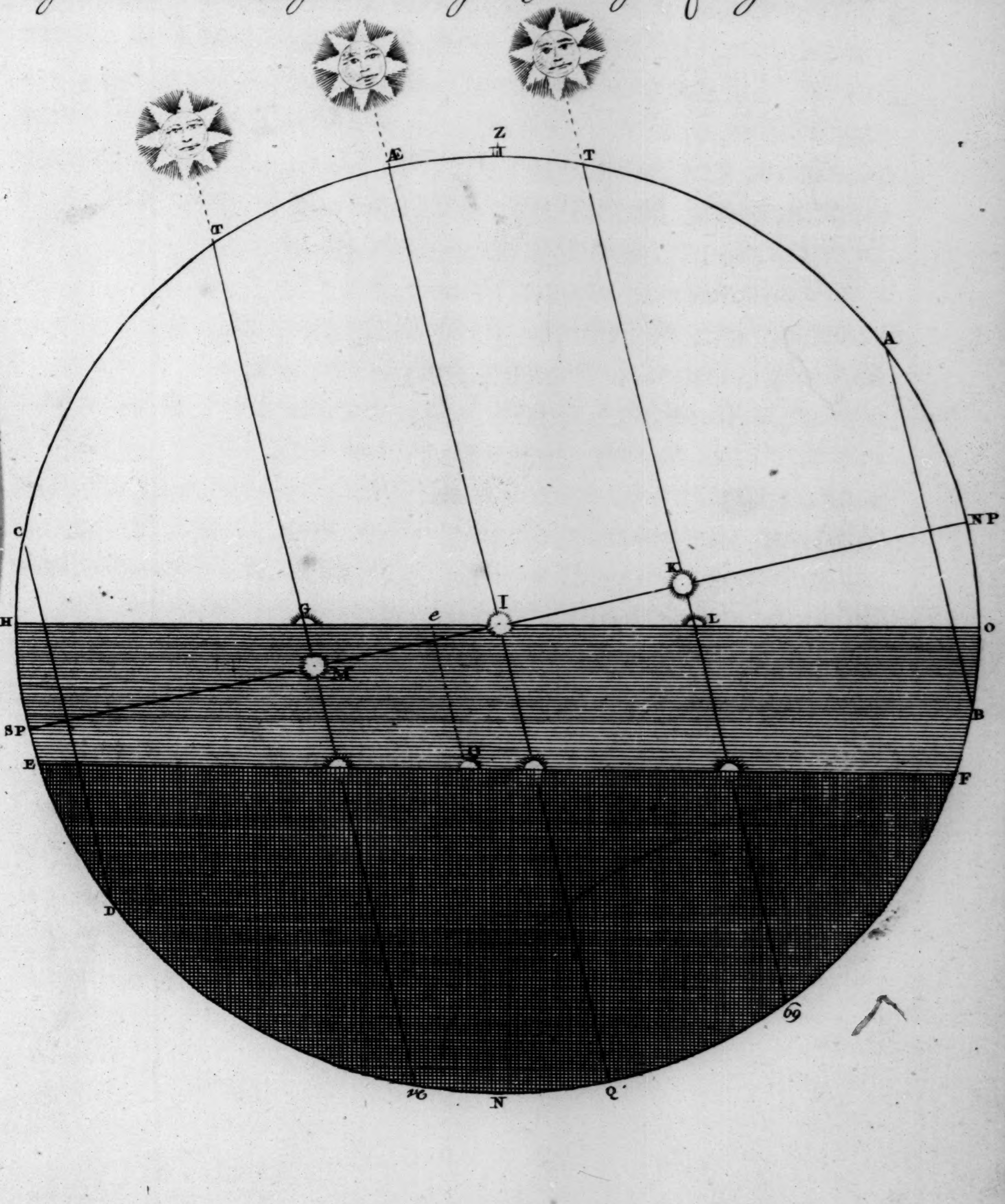
From *June* 21 to *September* 23, the ſun returns from the tropick of cancer T, ſouthward to the equator Æ Q, when it is equal day and night.

From





A Projection Shewing the Length of Days & Nights in Barbadoe



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From *September* 23 to *December* 21, the ſun declines from the equator Æ Q, ſouthward to the tropick of capricorn T, which is the ſhorteſt day at *Barbadoes*, when the ſun riſeth 23 minutes after 6 from the horizon G, and ſetteth 37 minutes after 5; ſo that the ſhorteſt day is 11 hours 14 minutes, and the night 12 hours 46 minutes, and the twilight 1 hour 22 minutes.

Now obſerve the ſun on the meridian at the three ſeveral places T Æ and T, to the northward of *Barbadoes*, then becauſe the earth turneth each day once round its axis N P and S P, the ſun, in each of theſe places, will deſcribe a circle, one of which will be the equator Æ Q, and the other two, T and T, will be the parallel thereto, and are the tropicks of cancer and capricorn.

Now it is plain when the ſun hath paſſed half way from noon to midnight, it will be found in the line N P S P, in the points I K M, and then it is 6 o'clock; alſo when it toucheth the horizon G I L, it there ſetteth from our ſight, and conſequently terminateth the day, and begineth the night.

1*ſt*. Suppoſe the ſun on the equator Æ Q, then it is apparent that it will on *March* 21, and *September* 23, be in the horizon I, preciſely at 6 o'clock; and therefore his path by day will be juſt equal to the ſame by night.

2*d*. Suppoſe the ſun at T (to the northward of *Barbadoes*) on *June* 21, then it is at 6 o'clock in K, above the horizon; ſo that the dayly arch L T, is longer than the arch by night L, by the difference L K.

3*d*. Suppoſe the ſun in T, then the diurnal arch T G, is juſt as long as the nocturnal arch L before, and the diurnal arch is juſt as long as the nocturnal arch G.

That obſcure part comprehended between H E and O F, is the twilight, the line E F being 18 degrees 00 minutes below the horizon H O; during the time the ſun paſſeth from H O to E F, in the parallel of any day, his rays are partly refracted by the atmoſphere, ſo we have ſome faint light till he gets below E F, and then we are left in darkneſs. Obſerve the ſhorteſt twilight happens on the 12th of *October* and the 1ſt of *March*, for then the ſun deſcribes the parallel *e o*, which is the leaſt of H O and E F, if any, the twilight at *Barbadoes* being but 1 hour 7 minutes at that time.

Now to meaſure the time of the ſun's riſing and ſetting on this projection proceed thus: Take the ſemicircle of ſinical hours * and lay it on the tropick of cancer (as hath been deſcribed) with the figure VI. on the 6 o'clock line, with the figures I, II, III, *&c.* below the horizon, where you will find the horizon to cut the ſemicircle at 37 minutes after V, the time of the ſun riſing; then by turning the ſemicircle, the figures VII, VIII, *&c.* below the horizon you will find the horizon cut 23 minutes after VI, and by ſtaying it there, it ſhews the twilight to be 1 hour 22 minutes. Now for the length of the day and night take this rule: The time of the ſun riſing doubled is the length of the night, and ſun ſetting doubled is the length of the day.

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* See the uſe and deſcription of it in the following chapter.

CHAP.

8

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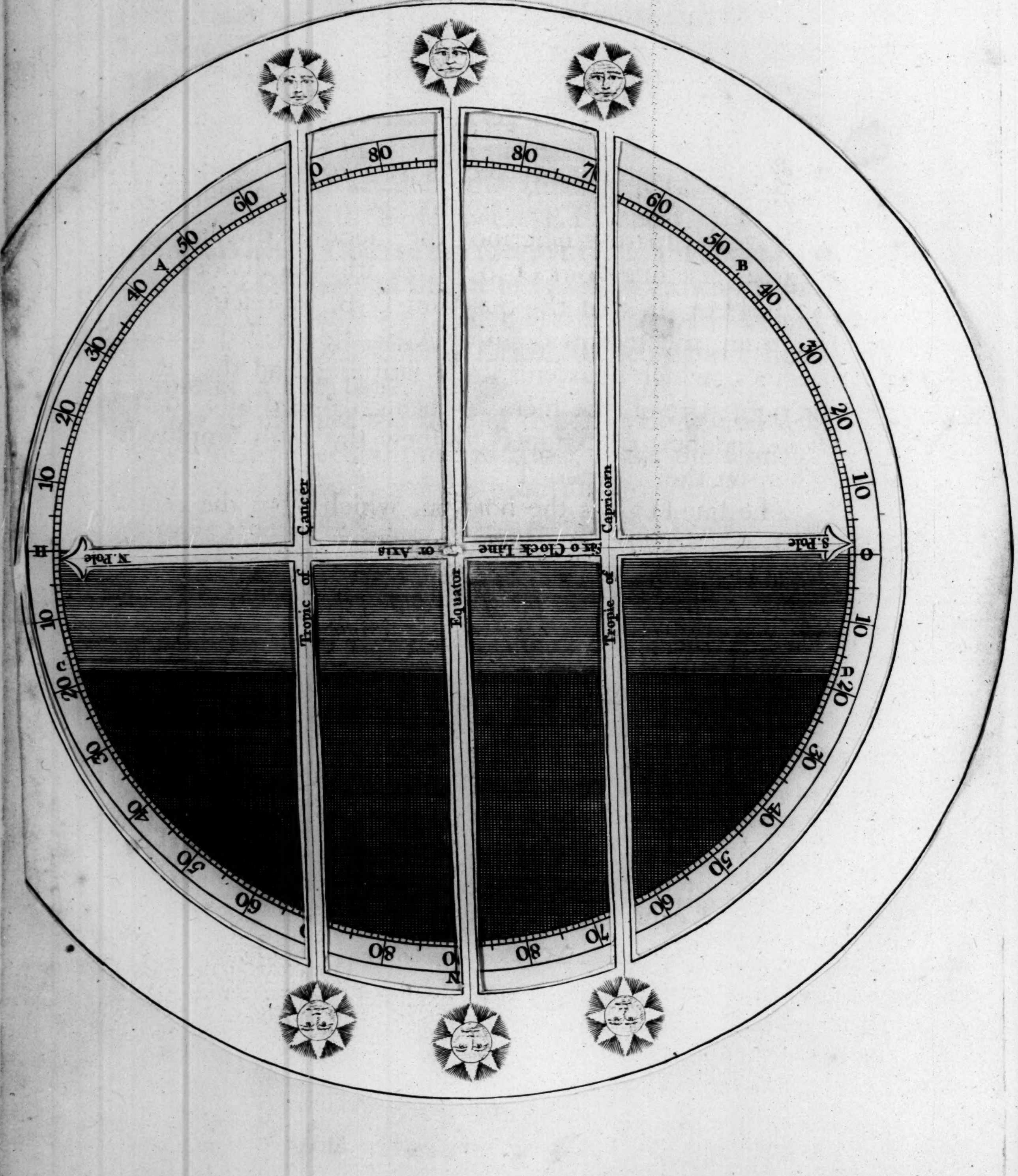
the Description and use of it.



CHAP. III.

Deſcription and Uſe of the Planiſphere, and Semicircle of Sinical Hours. (Plate II.)

THIS planiſphere conſiſts of two parts, one unmoveable the other moveable. On the firſt and unmoveable part is deſcribed the meridian divided into degrees, as thus from O to the zenith * is divided into 90 degrees, ſo that the quadrant O B, repreſents north latitude; and the quadrant H A, is alſo divided into 90 degrees, which repreſents ſouth latitude; and the lower, or right part of the meridian being divided alſo in the ſame manner, is deſigned to ſhew the ſun's amplitude when on the tropicks.

The line H O, is the horizon, which from the center to O is called the north horizon, and from the center to H, is the ſouth horizon.

The diſtance from H to C, and O to D, is the twilight, and that part under the line C D is night.

The zenith and nadir are two points diametrically oppoſite to each other, as is repreſented by N. the nadir, and the point oppoſite.

The ſecond, or moveable part, conſiſts of the axis, or 6 o'clock line, the north and ſouth poles mark'd S. P. for ſouth pole, and N. P. for north pole; the northern tropick, or tropick of cancer; the ſouthern tropick, or tropick of capricorn, and the equator.

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* See zenith in the deſcription of the firſt plate.

On the outer part, in a circle, is the ſun on the tropicks and equator, which will help to form an idea of the difference of heat and cold in the ſeveral parts of the earth.

The ſemicircle of ſinical hours is divided, the outer arch into 12 hours; the ſecond arch into 180 degrees 00 minutes, and every 15 degrees 00 minutes making an hour of time, is drawn into ſinical hours, half hours, and quarters. Having given a deſcription of the planiſphere and ſemicircle, I ſhall next proceed to ſhew their uſe.

EXAMPLE I.

Required the time of the ſun riſing and ſetting, and the length of the longeſt and ſhorteſt days and nights, (when the ſun is on the tropicks) at *Copenhagen* in *Denmark.*

OPERATION I.

Look in the table of latitude and longitude, *&c.* for the latitude of *Copenhagen*, which you will find to be 56 degrees 13 minutes north, then elevate the north pole to little more than 56 degrees 00 minutes on the meridian, and there ſtay it; then take the ſemicircle and lay it on the tropick of cancer, the figure VI, right on the 6 o'clock line; the figures I, II, *&c.* below the horizon, and the horizon will cut the ſemicircle at 20 minutes after 3, the time of the ſun riſing; then, by turning the ſemicircle upſide down on the ſaid tropick, the horizon will cut the ſemicircle at 40 minutes after 8, the time of ſun ſetting. Now the time of ſun ſetting being doubled, is 17 hours 20 minutes, the length of the longeſt day at *Copenhagen*; the hours on the ſemicircle, below the horizon, being 3 hours 20 minutes, which doubled, is 6 hours 40 minutes, the length of the ſhorteſt night, though they have no night but twilight at that time. You may obſerve that the ſhorteſt night, when the ſun is on the tropick of cancer, is juſt the length of the day when the ſun is on the tropick of capricorn; and the longeſt day, when the ſun is on the tropick of cancer, is juſt the length of the longeſt night, when he is on the tropick of capricorn. As thus, the ſhorteſt day is 6 hours 40 minutes, and longeſt night 17 hours 20 minutes; the ſun riſeth on the ſhorteſt day there at 40 minutes after 8 o'clock, and ſetteth at 20 minutes after 3 o'clock.

EXAMPLE II.

Required the time of the ſun riſing and ſetting at *Cape Horn*, and length of the day and night there when he is on the tropick of cancer, it being then ſummer at *London*, but winter at *Cape Horn*.

OPERATION II.

Look in the table of latitude and longitude for *Cape Horn*, and you find it is in latitude 57 degrees 30 minutes ſouth; then elevate the ſouth pole to the latitude on the meridian, and apply the ſemicircle as before directed, to the tropick of cancer, and you will have the horizon cut it at 45 minutes after 8, the time of ſun riſing; and by turning the ſemicircle, you will have the horizon cut it at 15 minutes after 3, the time of the ſun ſetting. Now the ſun ſetting doubled, is the length of the day, *viz.* 6 hours 30 minutes, and the ſun riſing doubled, is the length of the night 17 hours 30 minutes.

EXAMPLE III.

Required the length of the days and nights, when the ſun is on the tropicks, at *Canton* in *China*; alſo the time of the ſun riſing and ſetting, and length of the twilights at thoſe times.

OPERATION III.

Look in the tables of latitude, *&c.* for *Canton*, and you will find it is in latitude 23 degrees 20 minutes north; then elevate the north pole to the latitude on the meridian, and apply the ſemicircle as directed in the firſt example to the tropick of cancer, and you will find the horizon to cut it at 20 minutes after 5, the time of ſun riſing, when on the ſaid tropick, and by turning the ſemi-circle, the horizon will cut at 40 minutes after 6, the time of ſun ſetting; then apply the ſemi-circle on the tropick of capricorn, as directed to find the ſun's riſing, by the 1ſt example, and the horizon will cut it at 40 minutes after 6, the time of ſun riſing, and by turning the ſemi-circle, for ſun ſetting, the horizon will cut it at 20 minutes after 5, the time of ſun's ſetting; ſo the longeſt day is 13 hours 20 minutes, and the ſhorteſt night 10 hours 40 minutes; and the ſhorteſt day 10 hours 40 minutes, and the longeſt night 13 hours 20 minutes;

and for the twilight count what time is on the ſemi-circle from ſun ſetting to the dark part, or night, and you will find it to be 1 hour 40 minutes.

EXAMPLE IV.

Required, the time of ſun-riſing and ſetting, and the lengths of the days, nights, and twilight at *London*, when the ſun is on the tropicks.

OPERATION IV.

Look in the tables of latitude, &c. for *London*, and you find it to be in latitude 51 degrees 30 minutes N. Then elevate the north pole to the latitude on the meridian, and apply the ſemicircle as directed in the firſt example on the tropick of *Cancer*, and the horizon will cut it at 50 minutes after 3, which is the time of the ſun riſing then, and turn the ſemi-circle and the horizon will cut it at 10 minutes after 8, the time of ſun ſetting then; and the length of the day is 16 hours 20 minutes, and the night 7 hours 40 minutes, and the twilight is 3 hours 50 minutes; and when the ſun is on the tropick of *Capricorn*, it is 2 hours 0 minutes, the ſun riſeth at 10 minutes after 8, and ſetteth at 50 minutes after three, when on this tropick, ſo that the ſhorteſt day is 7 hours 40 minutes, and the longeſt night is 16 hours 20 minutes.

The examples and directions for the uſe of the planiſphere, &c. already given, may be ſufficient to teach any one the uſe, ſo that I ſhall add ſeveral queſtions for practice without the operation.

EXAMPLE. V.

Required, the time of ſun riſing and ſetting, with the length of the days, nights, and twilight at *Port Royal*, in *Jamaica*, when the ſun is on the tropicks.

EXAMPLE VI.

Required, the time of the ſun riſing and ſetting, with the length of the days, nights, and twilight, at *Rome*, when the ſun is on the tropicks.

EXAMPLE VII.

Required, the time of ſun riſing, and ſetting, and length of the days, nights, and twilight, at *Madrid*, in *Spain*, when the ſun is on the tropicks.

EXAMPLE VIII.

Required, the time of the riſing and ſetting of the ſun, and length of the days, nights, and twilight, at *Port Mahon*, on the iſland *Minorca*, when the ſun is on the tropicks.

EXAMPLE IX.

Required, the time of the riſing and ſetting of the ſun, *June* the 21ſt, and *December* the 21ſt, *September* the 23d, and *March* the 21ſt, with the length of the days, nights and twilight, at the iſland of *St Helena*.

EXAMPLE X.

Required, the time of ſun riſing and ſetting, and length of the days, nights, and twilights, on *December* the 21ſt, *March* the 21ſt, *Jnne* the 21ſt, and *September* the 23d, at *Leghorn*.

EXAMPLE IX.

Required, the time of ſun riſing and ſetting, and length of the day and night, on the 21ſt of *June*, at the *Havanah*.

EXAMPLE XII.

Required, the time of ſun riſing and ſetting, with the length of the day, night, and twilight, on the 21ſt of *June*, at the *Cape of Good Hope*.

EXAMPLE XIII.

Required, the time of ſun riſing and ſetting, with the length of the days, nights, and twilight, on the 21ſt of *June*, at the iſland *St Catherines*, on the coaſt of *Brazil*.

EXAMPLE XIV.

Required, the time of ſun riſing and ſetting, and length of the day, night, and twilight, on the 21ſt of *December*, at *Cape St Maria*, on the coaſt of *Brazil.*

EXAMPLE XV.

Required, the time of ſun riſing and ſetting, and length of the day and night, on the 21ſt of *December*, at *Stockholm* in *Sweden.*

EXAMPLE XVI.

Required, to project a right ſphere.

OPERATION XVI.

Bring the poles in the horizon, and then the equator will make right angles with the horizon, and therefore is called a right ſphere. The inhabitants whoſe ſphere is in this poſition have their days and nights of equal length at all times of the year, and conſequently live under the equinoctial, or on the equator, and as the ſun ſhines perpendicular, have very hot weather all the year round; and all places that are ſituated between the tropicks have a great heat from the ſun.

EXAMPLE XVII.

Required, to project a parallel ſphere.

OPERATION. XVII.

Bring the poles to the zenith and nadir, and there the equator will be in the horizon, and the tropicks parallel thereto, and therefore is called a parallel ſphere. The inhabitants, if any ſo miſerable, whoſe ſphere is in this poſition, have one half the year day, and the other half the year night and twilight ; and as the ſun's rays fall with a great obliquity on them, they muſt have exceſſive cold weather all the year, tho' warmer at one time than the other.

EXAMPLE XVIII.

Required, to project an oblique ſphere.

OPERATION XVIII.

Elevate either the north or ſouth pole 30 degrees 0 minutes, on the meridian, ſo have you an oblique ſphere, as the equator makes an oblique angle with either the north or the ſouth horizon, (an oblique angle being more than 90 degrees 0 minutes, a right angle 90 degrees 0 minutes, an acute angle leſs than 90 degrees 0 minutes). If the north pole is elevated, then the equator makes an oblique angle with the north horizon; if the ſouth pole, the contrary. In this poſition of the ſphere we have the day and night of equal length twice a year, which are the times he is on the vernal and autumnal equinoxes; and ſince the ſun each day deſcribes by his apparent diurnal motion, ſome parallel from the time of the vernal equinox, to the ſummer ſolſtice, the days grow longer and longer, and will be continually longer than the nights; after the ſummer ſolſtice, tho' the days continue to the autumnal equinox to be longer than the nights, yet they become ſhorter and ſhorter, and at the equinox they but juſt equal the nights. From thence to the winter ſolſtice, the days continually become ſhorter than the nights, and are the ſhorteſt when the ſun is in that ſolſtice, but as the ſun leaves it they increaſe again, and in the vernal equinox the day is as long as the night.

N.B. That the ſummer ſolſtice is on the 21ſt of *June* in north latitude, but on the 21ſt of *December* in ſouth latitude, and the winter ſolſtice in north latitude is on the 21ſt of *December*, but in ſouth latitude on the 21ſt of *June*; and the autumnal equinox in north latitude is on the 23d of *September*, but in ſouth latitude on the 21ſt of *March*; and the vernal equinox in north latitude is on the 21ſt of *March*, but in ſouth latitude on the 23d of *September*; ſo that when it is winter to us in north latitude, it is ſummer to them in ſouth latitude, and when it is winter to them in ſouth latitude, it is ſummer to us in north latitude.

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EXAMPLE XIX.

To find the Sun's Meridian Altitude.

Required, the ſun's meridian altitude, or height above the horizon, when on the meridian on the 21ſt of *June*, 23d of *September*, 21ſt of *March*, and 21ſt of *December*, at *London.*

OPERATION XIX.

Elevate the north pole to the latitude of *London*, as *per* table, and you will find the tropick of *Cancer* to cut the meridian at 62 degrees 0 minutes, the meridian altitude for the 21ſt of *June*; and the equator to cut the meridian at 38 degrees 0 minutes, the meridian altitude on the 23d of *September*, and 21ſt of *March*; and the tropick of *Capricorn* to cut the meridian at 15 degrees 0 minutes, the meridian altitude on the 21ſt of *Dec.*

EXAMPLE XX.

Required, the ſun's meridian altitude on the 21ſt of *June* and 21ſt of *December*, 23d of *September* and 21ſt of *March*, at *Rome.*

OPERATION XX.

Elevate the north pole to the latitude, *per* table, and you will find the equator to cut the meridian at 48 degrees 0 minutes, the meridian altitude on the vernal and autumnal equinox; and the tropick of *Cancer* to cut the meridian at 73 degrees 0 minutes, the meridian altitude on the ſummer ſolſtice; and the tropick of *Capricorn* to cut the meridian at 25 degrees 0 minutes, the meridian altitude on the winter ſolſtice.

EXAMPLE XXI.

Required, the ſun's meridian altitude on the ſummer and winter ſolſtice, and on the vernal and autumnal equinoxes, at *Athens*.

OPERATION XXI.

Elevate the north pole to the latitude, *per* table, and you will find the equator to cut the meridian at 52 degrees 0 minutes, the meridian altitude on the vernal and autumnal equinoxes; and the topick of *Cancer* to cut the meridian at 76 degrees 0 minutes, the meridian altitude on the ſummer ſolſtice; and the tropick of *Capricorn* to cut the meridian at 30 degrees 0 minutes, the meridian altitude on the winter ſolſtice.

EXAMPLE XXII.

Required, the ſun's meridian altitude on the 21ſt of *December*, 21ſt of *June*, 23d of *September*, and 21ſt of *March*, at *Cape Horn*.

OPERATION XXII.

Elevate the ſouth pole to the latitude, *per* table, and you will have the equator cut the meridian at 33 degrees 0 minutes, the meridian altitude on the vernal equinox the 23d of *September*, and autumnal equinox on the 21ſt of *March*; and the tropick of *Capricorn* cut the meridian at 59 degrees 0 minutes, which is the meridian altitude, on the 21ſt of *December*, the ſummer ſolſtice; and the tropick of *Cancer* to cut the meridian at 12 degrees 0 minutes, the meridian altitude, on the 21ſt of *June*, the winter ſolſtice.

EXAMPLE XXIII.

Required, the ſun's meridian altitude, on the ſummer and winter ſolſtice, and on the vernal and autumnal equinoxes, at *Gibraltar*.

OPERATION XXIII.

Elevate the north pole to the latitude, *per* table, and the equator will cut the meridian at 54 degrees 0 minutes, the meridian altitude on the vernal and autumnal equinoxes; and the tropick of *Cancer* cut the meridian at 78 degrees 0 minutes, the ſun's meridian altitude on the ſummer ſolſtice; and the tropick of *Capricorn* cut the meridian at 34 degrees 0 minutes, the meridian altitude when on the winter ſolſtice.

EXAMPLE. XXIV.

Required, the ſun's meridian altitude, on the ſummer and winter ſolſtice, and on the vernal and autumnal equinoxes, at Cape St *Maria*, on the coaſt of *Brazil*.

OPERATION XXIV.

Elevate the ſouth pole to the latitude, *per* table, and the equator will cut the meridian at 55 degrees 30 minutes, the ſun's meridian altitude on the vernal equinox, which in this latitude is on the 23d of *September*, and the autumnal equinox, which is on the 21ſt of *March*; and the tropick of *Cancer* will cut the meridian at 32 degrees 0 minutes, the ſun's meridian altitude on the winter ſolſtice, the 21ſt of *June*; and the tropick of *Capricorn* will cut the meridian at 78 degrees, the ſun's meridian altitude on the ſummer ſolſtice, the 21ſt of *December*.

Here follows ſeveral examples to exerciſe the reader, which may be anſwered without my giving any farther directions, having ſhewn the operations of the others at large.

EXAMPLE XXV.

Required, the ſun's meridian altitude on the 21ſt of *June*, at *Paris*.

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EXAMPLE XXVI.

Required, the ſun's meridian altitude, on the 21ſt of *December*, at *Madrid*.

EXAMPLE XXVII.

Required, the ſun's meridian altitude when on the winter ſolſtice, at *Liſbon*.

EXAMPLE XXVIII.

Required, the ſun's meridian altitude when on the ſummer and winter ſolſtices, at *Madeira*, one of the *Canary Iſlands*.

EXAMPLE XXIX.

Required, the ſun's meridian altitude when on the ſummer and winter ſolſtices, vernal and autumnal equinoxes, at *Pekin* in *China*.

EXAMPLE XXX.

Required, the ſun's meridian altitude when on the ſummer and winter ſolſtices, and vernal and autumnal equinoxes, at Cape *Virgin Mary*, *Magellan*'s *Straits*.

As theſe examples already given are ſufficient to enable any perſon to uſe the planiſphere with pleaſure, with reſpect to the finding the length of the days, nights, and meridian altitude, &c. I ſhall next proceed to give the deſcription and uſe of the orthographic projection, as follows:

CHAP. IV.

Deſcription and Uſe of the moveable orthographic Projection. PLATE III.

IT conſiſts of three parts, the firſt unmoveable, on which is deſcribed the 24 hours of the equinoctial, and may repreſent that circle, each hour being divided into five equal parts, each part being twelve minutes of an hour. At twelve on the upper part is the ſun, ſignifying that part to be twelve at noon, and the figures twelve on the lower part to be twelve at night.

The ſecond, or moveable part, contains ſeveral circles, between the two outermoſt are the degrees of longitude; thoſe on the right hand of the meridian of *London* are mark'd E, which ſignifies the longitude to be eaſt from the meridian of *London* to 180 degrees, the oppoſite part of the meridian; and thoſe on the left hand of the meridian of *London* are mark'd W, which ſignifies the longitude to be weſt from the meridian of *London* to 180 degrees, the oppoſite part of the meridian.

The circle next that on which the letters and figures are, is the equator, and mark'd E Q; on this are laid off the degrees of longitude, every 15 degrees being divided into five parts, each being three degrees, ſo as to anſwer the outer circle, or equinoctial.

The circle mark'd T is the tropick, and may be either *Cancer* or *Capricorn*; and the circle mark'd P.C. is the polar circle, and may be either the arctic or antarctick.

The other circles are parallels of latitude, the firſt being the parallel of *Port Royal*, *Jamaica*, in its proper latitude and longitude.

The circle next the tropick is the parallel of *Antioch*, in its proper latitude and longitude.

The circle next is the parallel of *Liſbon*, prick'd down in its proper latitude and longitude.

The next circle is the parallel of *Pekin*, in *China*; the next *Genoa*, in *Italy*; the next being *London*, on the primary, or firſt meridian; the next parallel is of Cape *Henrietta Maria*, on the coaſt of *North America*; the next is the parallel of *Copenhagen*, in *Norway*; and the northmoſt within the polar circle is Cape *Gallant*, on the coaſt of *Norway*, all being prick'd down in their proper latitudes and longitudes. The deſign of pricking theſe places down is to ſhew their ſituation on the globe, and will inſtruct the reader to prick any place down in a ſhort time, as this projection will ſerve for both north or ſouth latitude.

The center of this projection repreſenteth the arctic or antarctick pole, and the lines drawn from the center to cut the equator at every 15 degrees, are meridians; the third part is a moveable index; on it are deſcribed the parallels of latitude from the equator, as thus, 5, 10, 15, 20, &c. to 90 degrees, which is the pole either north or ſouth.

Having deſcribed the moveable hemiſphere, or orthographic projection, I ſhall ſay ſomething concerning time by the longitude.

Take notice, that at all places in eaſt longitude the ſun cometh on their meridian before he cometh on the meridian of *London*; as thus, if a place lies 15 degrees eaſt longitude, the ſun cometh one hour ſooner to the meridian there, than he doth to the meridian of *London*; if in 30 degrees eaſt longitude, then two hours ſooner; if in 45 degrees, three hours ſooner; if in 60 degrees, four hours ſooner; if 75 degrees, five hours ſooner; if 90 degrees, ſix hours ſooner; if 105 degrees, ſeven hours ſooner; and ſo you may reckon for any other longitude, by allowing for every 15 degrees of the equator 1 hour of time, for every degree 4 minutes, and for every minute 4 ſeconds of time, &c. But all thoſe places that lie in weſt longitude, the ſun cometh on their meridian after he hath been on the meridian of *London*, according to the above allowances.

Uſe of the MOVEABLE PROJECTION.

EXAMPLE I.

Required, the time at *Pekin* in *China*, when twelve at noon at *London*.

OPERATION I.

Find the longitude of *Pekin* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and there ſtay it, then turn the index to the longitude of *Pekin*, as *per* table, and it will cut 48 minutes after 7 in the afternoon, on the hour circle, or equinoctial, which is the time required.

EXAMPLE II.

Required, the time at *Port Royal*, *Jamaica*, when it is twelve at noon in *London*.

OPERATION II.

Find the longitude of *Port Royal*, by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there; then turn the index to the longitude on the equator, and the edge of the index will cut 56 minutes after 6 in the morning, on the hour circle, the time required.

EXAMPLE III.

Required, the time at *Liſbon* when twelve at noon in *London*.

OPERATION III.

Find the longitude of *Liſbon* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there; then turn the index to the longitude on the equator, and it will cut 28 minutes after 11 in the forenoon, on the hour circle, which is the time required.

EXAMPLE IV.

Required, the time at *Copenhagen* in *Denmark*, when twelve at noon in *London*.

OPERATION IV.

Find the longitude of *Copenhagen* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there, turn the index to the longitude on the equator, and it will cut 54 minutes after 12 at noon, on the hour circle, which is the time required.

EXAMPLE V.

Required, the time at Cape *Gallant*, on the coaſt of *Norway*, when it is twelve at noon in *London*.

OPERATION V.

Find the longitude of Cape *Gallant* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there, and turn the index to the longitude on the equator, and it will cut 18 minutes after two in the afternoon on the hour circle, the time required.

EXAMPLE VI.

Required, the time at Cape *Henrietta Maria*, on the coaſt of *North America*, when twelve at noon in *London*.

OPERATION VI.

Find the longitude of Cape *Henrietta Maria* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there; then turn the index to the longitude on the equator, and it will cut 36 minutes after ſix in the forenoon on the hour circle, which is the time required.

EXAMPLE. VII.

Required, the time at *Antioch*, in the *Straits*, when twelve at noon in *London*.

OPERATION VII.

Find the longitude of *Antioch*, by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there; then turn the index to the longitude on the equator, and it will cut 29 minutes after two in the afternoon on the hour circle, the time required.

EXAMPLE VIII.

Required, the time at *Genoa*, in *Italy*, when it is twelve at noon in *London*.

OPERATION VIII.

Find the longitude of *Genoa* by the tables of latitude and longitude, then bring the meridian of *London* to twelve at noon, and ſtay it there; then turn the index to the longitude, on the equator, and the index will cut 39 minutes after twelve at noon on the hour circle, which is the time required.

Having ſhewed the uſe of this contrivance thus far, I ſhall next endeavour to inſtruct the reader to prick down any place on it, by the following directions.

RULE.

Having found the latitude and longitude of the place by the tables, you intend to mark down, move the index to the longitude on the equator, and ſtay the index there; then look for the latitude on the index, and make a mark cloſe to the edge of the index, even with the latitude, with a black lead pencil, and that will be the ſituation of that place on the globe. This direction being ſufficient to ſhew how to prick any place down, I ſhall proceed to give ſome examples without operations, in order to exerciſe the reader.

EXAMPLE IX.

Required, the time at *Canton*, in *China*, when it is twelve at night in *London*.

EXAMPLE X.

Required the time at *Conſtantinople*, in *Turky*, when it is ten at night in *London*.

EXAMPLE XI.

Required, the time at *London* when ten at night at *Port Royal*, in *Jamaica*.

EXAMPLE XII.

Required, the time at *Fort St David*'s, in the *Eaſt Indies*, when it is twelve at noon in *London*.

EXAMPLE XIII.

Required, the time at *Charles Town*, in *South Carolina*, when twelve at noon in *London*.

EXAMPLE XIV.

Required, the time at *Peterſburgh*, in *Ruſſia*, when twelve at noon in *London*.

EXAMPLE. XV.

Required, the time at *London* when the *Great Mogul* is at dinner at *Agra*, which is his court, ſuppoſe him at dinner at two in the afternoon.

EXAMPLE XVI.

Required, the time at *Pekin*, in *China*, when four in the morning at *London*.

EXAMPLE XVII.

It being eight in the forenoon at *Barbadoes*, what time is it at *Rome*, *Naples*, and the iſland of *Malta*.

EXAMPLE XVIII.

It being twelve at noon at *Richmond*, in *Surry*, what time is it at *Fort St George*, in the *Eaſt Indies*.

EXAMPLE XIX.

It is ſix in the morning at *Fort St George*, what time is it at *Richmond*.

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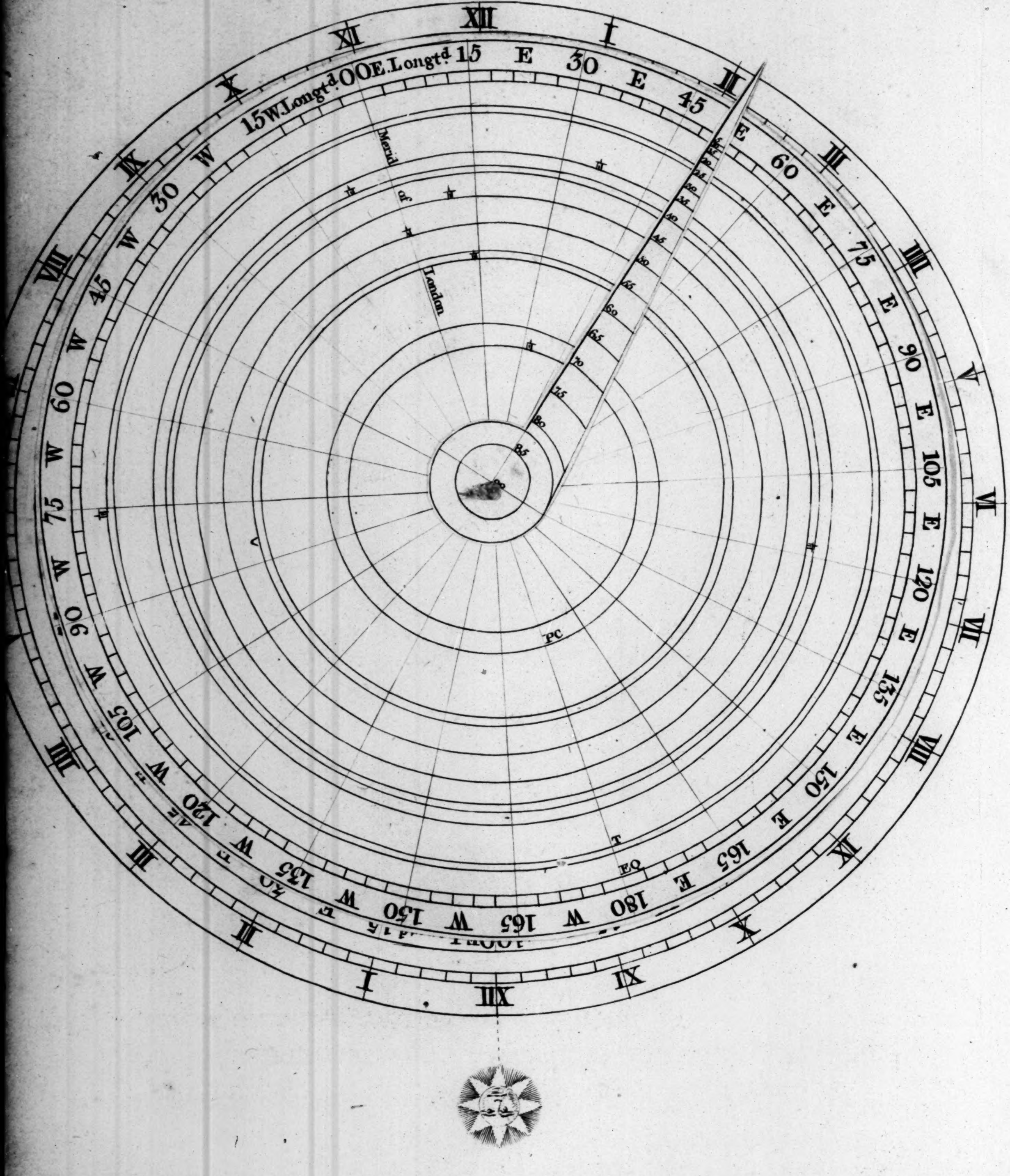
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EXAMPLE XX.

It is twelve at noon at *Leghorn*, in *Italy*, what time it is at *Barbadoes*.

EXAMPLE XXI.

It is eight in the forenoon at *London*, what time is at *St Helena*.

EXAMPLE XXII.

It is twelve at noon in *Richmond*, what time is it at *Batavia*, in the *Eaſt Indies*.

* * *

CHAP. V.

Of HEAT *and* COLD.

BY the moveable planiſphere already deſcribed may be demonſtrated the following reaſons for the variety of heat and cold, in the different parts of the world, which being divided into five zones, *viz.* one torrid, or burning, two temperate, and two frigid or frozen zones, which I ſhall deſcribe as follows: The torrid, or burning zone, is all that ſpace of earth and water which is limited by the tropicks; now it is very hot to the inhabitants of this zone at all times of the year, becauſe the rays of the ſun fall more perpendicular there than they do in the other zones, for the nearer we come to the poſition of a right ſphere, the more direct the rays of the ſun, and the greater the quantity, and conſequently ſtrikes through the atmoſphere with great force and celerity, which is very obvious, by ſetting the planiſphere at right angles; for obſerve, the ſun never departs from the inhabitants of this zone ſo as to ſhine with any great obliquity.

The northern temperate zone is that ſpace of earth and water, which is limited by the northern polar circle and the tropick of *Cancer*.

The ſouthern temperate zone is that ſpace of earth and water which is limited by the ſouthern polar circle, and the tropick of *Capricorn*; in theſe zones we have a winter and a ſummer: Now when it is ſummer in the northern temperate zone, it is winter in the ſouthern temperate zone; and when it is ſummer in the ſouthern, then winter in the northern. In ſummer the ſun's rays fall more perpendicular on us, and the earth being heated twice by the ſun, makes it warmer at that time of the year, which we call the dog days, than in any part of the ſummer. In winter, his rays falling with greater obliquity, muſt come very faint to the earth, and the nights being longer than the days, the earth hath more time to cool; for in winter the ſun hath a greater quantity of atmoſphere to penetrate, than in the ſummer. The northern and ſouthern frozen zones are limited by the polar circles; in theſe zones it is very cold at all times, notwithſtanding the ſun is near half the year above the horizon, his rays falling with ſo great an obliquity, come very faint to the earth, and the other half year being night, it muſt be exceſſive cold. By forming a parallel ſphere with the planiſphere, will demonſtrate what hath been ſaid concerning the heat and cold in the parts of the world now treated of.

CHAP. VI.

Of the TWILIGHT.

IF we had no atmoſphere, we ſhould have no twilight, for it is the principal cauſe, as ſhall be ſhewn hereafter; were we depriv'd of this great bleſſing, we ſhould be convinc'd it would be attended with the following inconveniencies. *Firſt*, We ſhould be ſurrounded with darkneſs till the moment of ſun riſing. *Secondly*, It would break out in an inſtant from under the horizon, ſhew itſelf the ſame as it would appear towards the middle of its courſe, and would not in the leaſt change his appearance till the inſtant of his ſetting, when it would be equally obſcure and dark as the middle of the darkeſt night.

The ſun, indeed, would ſtrike our eyes with a lively brightneſs, but it would only reſemble a clear fire which we ſhould ſee during the night in a ſpacious field. It would be day light, and we ſhould ſee the ſun and the adjacent objects round us, but the rays which fell on ſuch lands as are remote, would be loſt.

But ſince there is an atmoſphere covering the earth, and is illuminated by the ſun, it reflects the light back to us, and makes the heavens to ſhine, and that ſo ſtrongly, that it renders the ſtars inviſible.

But by the means of the atmoſphere it happens, that, though after ſun ſetting we receive no direct light from the ſun, yet we enjoy its reflected light for ſome time; ſo that the darkneſs of the night comes not ſuddenly, but by degrees.

For after the earth, by its revolution round its axis, hides the ſun from us, the atmoſphere, which is higher than us, will ſtill be illuminated by the ſun, ſo that for a while the whole heavens will have ſome of his light imparted to it; but as the ſun goes lower under the horizon, the leſs is the air illuſtrated by him; ſo that when he is 18 degrees below the horizon, he no longer enlightens our atmoſphere, and then all that part that is over us becomes dark.

Likewiſe in the morning, as ſoon as the ſun comes within 18 degrees of the horizon, he begins again to enlighten the atmoſphere, and diffuſe his light through the heavens; ſo that its brightneſs decreaſes, till the ſun riſeth and makes full day.

This enlightening the atmoſphere, and ſtate of the heavens between day and night, is called twilight, which is obſerved in the morning, before ſun riſing, and at night, after his ſetting.

Though the reflection of the atmoſphere be a principal cauſe of twilight, yet aſtronomers aſſign a ſecond cauſe, which is, that there is an atmoſphere round the ſun, which ſhines after the body of the ſun is ſet, the ſun's atmoſphere riſing ſooner and ſetting later than the ſun itſelf ſhines out at mornings and evenings, in a circular figure, it being a ſegment of the ſun's atmoſphere cut by the horizon; its light is different to that reflected by our atmoſphere, and the duration much ſhorter than that made by the reflection of the earth's atmoſphere, which does not end till the ſun is 18 degrees below the horizon. In winter, the air being condens'd by the cold, is low, and on that account the twilights are ſooner over.

In the ſummer the air is rarified by heat, and therefore, being higher, remains longer enlightened by the ſun, ſo that the twilights laſt the longer, and the duration of the twilight is ſhorter at morning than at night.

In a right poſition of the ſphere, the twilights are quickly over, becauſe the ſun riſeth and ſetteth nearly in a perpendicular; but in an oblique ſphere they laſt longer, the ſun riſing and ſetting obliquely, and the greater the latitude of the place, ſo much longer laſt the twilights, ſo that all thoſe who are in 49 degrees of latitude in the ſummer, near the ſolſtice, have their atmoſphere enlightned the whole night, and the twilight laſts till ſun riſing, without any compleat darkneſs, as may be demonſtrated by the planiſphere.

In a parallel ſphere the twilights laſts for ſeveral months, ſo that the inhabitants of this poſition have either direct or reflex light of the ſun nearly all the year, as will plainly appear by uſing the planiſphere.

There is a great difference between the increaſe of the twilight and its decreaſe, and the increaſe and decreaſe of the days and nights, while the ſun moves from the beginning of *Cancer* to the firſt of *Capricorn*; all that time the days conſtantly decreaſe, and the nights increaſe; but in the twilight it is otherwiſe; for though the twilight and the days are at the longeſt when the ſun is in the 1ſt degree of *Cancer*, and then they both decreaſe together, yet the times of twilight do not continually decreaſe till the ſun comes to *Capricorn*. But there is a certain point between *Libra* and *Capricorn*, to which, when the ſun arrives, we have the ſhorteſt twilight, which happens on *October* the 12th, and *March* the 1ſt; and although the days from the beginning of the ſun's entry into *Capricorn*, do conſtantly increaſe, yet the twilights grow ſhorter till the ſun, in his return to the northern tropick, comes to the ſhorteſt twilight, which is demonſtrated by the planiſphere. Having ſaid as much as is neceſſary concerning heat, cold, and twilight, I muſt conclude with wiſhing the reader pleaſure and profit, ſo lay my pen aſide and reſt.

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